Programed Instruction and AV Personnel in the Future

DESMOND L. COOK

The author is head of the Planning and Methodology Division, Bureau of Educational Research and Service, The Ohio State University. This article is a revised version of his address at the spring meeting of the Audiovisual Directors of Ohio.

TO PROPHESY WHAT RESPONSIBILITIES AV specialists may have for programed instruction in the future requires audacity—especially in my case. For I consider myself neither an AV specialist nor an expert in programed learning. Having no strong personal identification in either area, I am neither fish nor fowl. My one hope is that my ideas are as strong as my nerve.

As a prelude to a look into the crystal ball, I should like to take a brief excursion to the past, and listen to some voices.

Thorndike is stating his now famous dictum that in education, too, whatever exists, exists in some amount, and hence can be measured (30). This statement, made in 1914, was looked upon then—and still is today—with some disfavor by individuals in the field of education. It was a rather provocative statement and without doubt ahead of its time. Noting this prematurity, Thorndike admitted that the processes of educational measurement were not far enough advanced at that time to support his contention fully. He stated that maybe not even 50 years later would techniques be developed so that the many human attributes could be adequately measured. While we still have a long way to go in the development of measurement-techniques in education, the history of those achieved since Thorndike's time reveals that tremendous progress has been made toward the fulfillment of his prophecy.

The second voice is that of Pressey writing in 1932 about the coming industrial revolution in the field of education (21). Pressey stated that education was a large-scale industry, and consequently should use quantity production methods. He was well aware that such an idea might be interpreted to support a mechanization of learning, but he did not mean to enforce such a viewpoint. He simply recognized that some educational activities, particularly testing and drill-work, could be accomplished by mechanical means, and thus could free

the teacher to develop more complex abilities. Unfortunately, Pressey chose to give up his work in the technology of education. To my knowledge no one has determined the precise reasons for his so doing. Perhaps the general unacceptance of his ideas was influenced by the fact that radio was beginning its adolescence, and the sound motion picture was only about 6 years old at that time. A suggestion that the teaching process be mechanized even in the mild manner devised by Pressey, let alone in any other way, would present a viewpoint well out of character with the times.

A voice now from outside of education talks about the educational process of the future. A well known industrialist, Simon Ramo (23), is describing the possible applications of new technological advances to the school of the future in such terms as "charga-plates," "push-button classes," "memorizing machines," "laboratory machines," and "teaching engineer." Since Ramo presented his concepts of the future of education in 1957, unfortunately many of the technological aspects of education he describes have not yet had the opportunity to develop, and thus to vindicate him as Thorndike and Pressey have somewhat been vindicated.

I have cited these voices simply to indicate that anyone who tries to predict the future, particularly in education, does so with a great deal of risk. He may be looked upon as a prophet without honor.

Though the changes foreseen by Pressey and Ramo have been slow in coming about, they are now gaining momentum. Finn aptly stated this forward surge in a recent issue of the *Phi Delta Kappan* (3) when he wrote that "almost all the current educational changes are related to, caused by, or are part of our developing instructional technology." Whether the new technology will take us as far as Ramo suggested remains to be seen, but like it or not, our efforts must be directed toward understanding this technology and becoming the master, not the slave.

An elaboration of the characteristics of instructional technology might be in order at this time for a different audience, but I am going to assume that readers of *AVCR* are familiar with the concepts, and get on with my special object: to consider the future responsibilities of AV specialists in one part of this technology—programed learning or programed instruction.

They will have some responsibility, if not the entire responsibility, for this technique provided that any responsibilities assigned or assumed are accepted in the context of not staying within the more traditional AV specialist's role, but of becoming a "learning technologist"—to use Finn's term. Programed instruction does not fall into the more commonly accepted definitions of audio-visual media. Thus, the AV specialist has to accept a broader definition of his task. He can no longer visualize his responsibilities as simply those that a good clerk could handle—such as ordering programs and machines, or preparing classroom schedules—and being a hardware mechanic.

If we accept the proposition that the present role of AV specialists will expand to include some of the responsibility for programed instruction, what will be the nature of that responsibility? As I see it now, there are five major tasks. They are (a) to understand the theoretical foundation; (b) to become familiar with program construction and development; (c) to experiment with the

techniques of utilization; (d) to know the processes of program evaluation; (e) to develop skill in human relations. My program here consists of a brief discussion of each of these areas of responsibility followed by reference to relevant new writings. Since the NEA already has the valuable resource book by Lumsdaine and Glaser on this topic (16), you may ask, "Why additional references?" My reply is simply straightforward. The field of programed instruction is expanding so rapidly that all concerned with it must give constant attention to new research findings and position papers.

Let us now examine each of the five areas of responsibility. Although the order of presentation does not necessarily represent a hierarchy of importance, the area discussed first is deliberately placed where it is.

Theoretical Foundations

I deeply believe that the major responsibility of any AV specialist now is to develop a comprehensive understanding of the background that led to programed instruction. To me, this means that he must develop an inquiring attitude toward learning theory in general, and toward operant conditioning or reinforcement theory in particular. To support this position, I mention the statement of one individual in an audio-visual journal that the *only* difference between Pressey and Skinner was in the *mode of student response* utilized by each. This observation not only reflects a failure to comprehend the true nature of Skinner's thinking, but also reveals a lack of understanding of what Pressey was trying to accomplish in the development of his early devices.

By stressing learning theory, I do not mean to minimize a need to know communication theory, social theory, systems theory or other similar areas; they all contribute to our understanding of this new technique. Of the various contributing areas, learning theory in my opinion offers the most with regard to the topic of concern here. I readily admit that present day learning theory does not fully account for all aspects of behavior change. Nevertheless, programed instruction developed from it, and we must understand this background to work most effectively with the new technique. To emphasize the need to understand current learning theory and its subsequent implications for programed instruction, I shall cite recent writings.

In the January 1962 issue of the *AV Communication Review* Geis presents an interesting discussion on the nature of reinforcement in programed instruction (7). He questions the assumption that immediate knowledge of results upon the making of obvious responses is a *universal* contingency for learning that response, thus motivating the student to want to move on in the program. He goes on to point out that the nature of reinforcement is still not fully understood. According to Geis, a program may fail to produce learning in an individual simply because the reinforcements supplied are ineffective for that individual. While admitting that there are perhaps universal reinforcements such as marks, and that we need to continue to search for others, he contends that reinforcement may be an *individual* and not a *group* matter. Because of this highly individualized nature of reinforcement, he boldly suggests that what we need is a test for reinforcement readiness so that acceptable reinforcements for each student could be identified, integrated, and used with a particular program.

Correlated with Geis's comments on reinforcement, some recent evidence obtained from a teaching machine demonstration at the Indiana State fair, conducted under fairly good experimental procedures in view of the situation, indicates that as degree of reinforcement increases (*i.e.,* knowledge of correct answer), attitude towards programed instruction become more negative with college educated persons but more positive with persons of eighth grade education. This finding could be used to support the idea that programed instruction is unattractive to the more capable student, and thus motivation is affected. Before drawing a final conclusion on this point, we still need much more evidence since the programs used in the demonstration were very short, and presented relatively simple content.

Logan, at a recent conference on new media theory, suggested that the so-called advantage of self-pacing provided by programed instruction may be somewhat questionable (14). In his research, evidence was obtained to support the thesis that a response should be learned under conditions similar to those wherein it will be recalled or used. For example, when a stimulus is presented slowly, a response is usually made slowly. On the other hand, a rapidly presented stimulus tends to bring about a fast response. When this principle is applied to programed instruction, it seems likely that students who are habitually allowed to work slowly on programs might become unable to produce their responses if not slowly paced, whereas those who customarily work rapidly would tend to give their responses quickly. Since real life situations often call for quick responses, individuals who are slowly paced may be placed at a disadvantage at a later time. Acceptance of this idea might mean that the program—not the individual—might set the pace for the learning.

These examples relevant to current learning theory are presented not as principles fully supported by empirical evidence—because they are not so supported—but rather to emphasize the need for the AV specialist to comprehend the full nature of learning theory as a definite responsibility. This responsibility includes not only awareness of basic research in the area but also of applied research. The latter will consist largely of experimental tryouts of programed materials, and will be of value in helping to implement programed instruction in a particular situation.

To develop further knowledge in the area of learning theory, I recommend the recent *AV Communication Review* Supplement on learning theory (10), Hilgard's chapter on learning in the symposium report, *New Teaching Aids in the American Classroom* (11), and *Teaching by Machine,* prepared by Dr. Stolurow (29).

Program Construction

Outlining the second area of responsibility, I assume—perhaps naively—that AV specialists have not thought that the *techniques* of producing films, filmstrips, and similar materials are a necessary part of their present responsibilities. Consequently, they may have focused instead upon the evaluation and utilization of materials produced by others. I do not believe this same situation will wholly prevail in programed instruction, for some programs will of necessity have to be locally constructed. Because the person most likely to do such local programing—the classroom teacher—will not have the time to develop a comprehensive knowledge of

programing principles, it may well become the audiovisualist's responsibility to know and fully understand these principles in order to help the programer. Why locally produced programs? The answer seems to me to be somewhat obvious. Just as with textbooks and other instructional materials, programs prepared by outside sources may or may not meet the stated instructional objectives in local situations. This means either changing the objectives to those of the adopted program or developing local programs to meet local objectives. Since I have a deep conviction that instructional materials and methods are utilized only to implement objectives and not vice versa, the alternative of modifying objectives to meet materials becomes unacceptable.

If the responsibility for program construction falls to AV specialists, they need to face important problems in this area. The first is the basic necessity of stating clearly and specifically the terminal behaviors that the student is expected to possess after completion of the program. The degree and kind of behaviors to be developed will be largely determined by the classroom teacher and the curriculum specialist. Audiovisualists can contribute immensely to their task by knowing how objectives should be stated so that the program can be built, and performance measured. Failure to provide behavioral definitions of objectives has been a source of instructional weakness for a long time. Programed instruction—if it makes no other future significant contribution—has already forced us to see the importance of such behavioral definitions in stating educational goals.

The second problem will be to know the slowly evolving principles or rules of program construction. Unfortunately, such principles are very limited in number at the present time and in some cases are not supported by experimental evidence. I hope that you do not hold to the two myths regarding program construction pointed out by Rothkopf (25). These are that programing principles sprang full bloom from the psychological laboratory, and that a psychologist knows more about programing than anybody else. While the psychologist and others can contribute to this skill, the best way to become acquainted with the complexity of programing is to try to do some of it in your own work.

The third problem is to be familiar with the types of materials that lend themselves easily to programing, and also with those that either have not yet been programed or cannot be. Those that have been successfully programed to date are largely verbal materials containing logical relationships, such as mathematics and English. We still lack evidence as to the degree to which such complex behaviors as attitudes, values, and problem-solving skills can be successfully programed. Just prior to my leaving Purdue, Dr. Perloff was beginning some experimental work in the area of advertising to see if programed material might be utilized to inform consumers about products and thus indirectly affect attitudes. Using retention measures, Friedland concluded that programed copy with answers supplied beneath each frame was more effective than the same copy in prose form or with answers supplied at the bottom of the page (6).

In considering what materials can or cannot be programed, I find myself becoming increasingly irritated with professional educators who say that programed instruction is fine for *training* and for *instruction* in skills, but not for

education. Emphasizing that education consists of more than instruction since it also aims at development of values, appreciations, and similar behaviors, they insist that these just cannot be mechanized or programed. As far as I know, no one in the field of programing at its present stage of development says we can achieve such highly desirable goals by this technique. It is interesting that those who so often attack programed instruction from this basis have yet to offer substantial evidence that such behaviors are being developed under current instructional procedures. I am inclined to be somewhat like Thorndike when he wrote in the same article earlier referred to, "I am suspicous of educational achievements which are so subtle and refined and spiritual that they cannot be measured. I fear that they do not exist." If, however, there are instructional processes existing in the schools today for the development of a wide variety of behaviors, and such desired behaviors are actually being achieved through these programs, then may it not be reasonable to assume that ultimately they might be brought into the area of *programed* instruction, broadly conceived? Lest I be immediately misunderstood, I do not mean to say that behaviors such as creativity and social relationships can be programed in the present use of the term. I doubt that they can be programed. There is probably no one single technique useful for achieving such behaviors. I do sincerely believe, on the other hand, that programed instruction can be used to develop a background from which creative ideas can emerge. From my limited knowledge of creativity, it does not spring out of any vacuum.

To develop some skills in program development and construction, I suggest that you start by reading Mager's excellent pamphlet titled, *Preparing Objectives for Programed Instruction* (17), the entertaining article on do-it-yourself programing by Rothkopf in the *Teachers College Record* (25), and the mimeographed materials on programing principles and problems available from Dr. Glaser, University of Pittsburgh (9).

Utilization of Programed Instruction

The two areas of responsibility previously discussed may not be the ones in which audiovisualists feel the greatest interest. The concern shared by many of you perhaps is simply: How do we use programed instruction? While there has been increasing use of programed instruction, it still has not been widely utilized. Gotkin (10) has perhaps given the reason for this situation when he writes, "Programed materials have not been used more . . . because performance of an implementation study requires considerable knowledge of the principles of programed instruction and close acquaintance with the program being used. To date, relatively few persons have known enough to feel free in their use of programs." In view of this statement, acceptance of the two previously cited areas of responsibility becomes important. How can we utilize something to best advantage if we do not understand it? The first consideration, then, in the utilization of programed instruction is an understanding of it.

Besides understanding it, what other factors might influence effective utilization of this new technique? I think that one of the main factors will be how one looks at the role of programed instruction. One might adopt Pressey's notion and use it as an adjunct to other instructional processes. In spite of opinion

somewhat to the contrary, this was also the approach used by Skinner. Others visualize the programing of whole courses of study. Edgar Dale in a personal conversation raised the question of whether or not a student should have programed material first, followed by subsequent discussion of the material, or have the discussion first, then the programed instruction. In the latter situation, the discussion would be a form of readiness-preparation for the other material. As far as I know, a final answer to this question does not exist, but the work of Pressey and Skinner in using the first procedure has been helpful.

In addition to considering the *order* of presenting programed materials, we need to know how it can be interrelated effectively with other instructional media. For example, Klaus and Lumsdaine have been working on a project in high school physics in which TV and programed instruction are supplements to each other (13). Early results indicate an advantage for this combination. Questions of this type relative to utilization are many, but unfortunately they far exceed the available answers.

One cannot, of course, utilize something which he does not know exists. Therefore, another factor determining utilization is a knowledge of programs in existence as well as which ones are being developed. This may seem a simple task until one looks at the article in the March 1962 issue of *Audiovisual Instruction* where 107 programs in mathematics, algebra, trigonometry, statistics, and even slide rule are listed as available in 1961 and 1962. Interestingly, mathematics has been one of the most heavily programed subjects, as noted by Finn and Perrin in their recent summary of current programs in all fields. Their listing showed 630 programs prepared by 50 companies in 10 content areas (4). Other descriptions of current programs presented by Rigney and Fry (24), and Foltz (5) would be helpful in becoming acquainted with the wide number and variety of programs available. I hastily point up two problems that exist here, as with published tests and textbooks. First, one cannot always accept the claims set forth by the publishers since it would be unnatural for them to cite limitations of their own products; second, listings become dated rather quickly.

This caution is presented not without reason. Chances are many that few schools will develop their own programs, but instead will mostly utilize published programs. Why is this so? The answer lies primarily in the cost factor. The development of a program for a year long program in high school physics has been estimated at around $70,000. There are not too many schools where that kind of money is available. Once developed and tried out in the field, however, and utilizing the paper book instead of the machine, a single program would cost about the same price as a textbook in the same area.

The cost factor enters into the utilization area in another way. Many persons still believe that a mechanical device is needed in order to make effective use of programed instruction. This is just not so. Paper programed textbooks have been and are being effectively used, and need not necessarily be consumed.

Another important factor in determining the utilization of the new technique is the extent to which we are willing to modify present school practices. I am thinking particularly of such things as providing time for independent work with the material, reorganization of the teachers' and students' day, pro-

viding individual work facilities in the school building, and similar changes. Excited as I am with the potentialities of instructional technology, I am not able to foresee the radical type of school building that many of the writers in the Sunday newspaper supplements have presented. Nevertheless, some modifications may have to be made for proper utilization of programed materials.

Unfortunately, there are not too many solid references on the topic of utilization other than those coming out of experimental studies. Sanborn's article in the *Educational Screen* for March 1962 might be useful since it presents a collection of teacher and student reactions to programed instruction, and is derived from Sanborn's observations as a director of instructional materials (26). The implementation studies noted in *Programed Instruction,* a bi-monthly bulletin issued by the Center for Programed Instruction of New York (22) would also be useful in seeing how programed instruction can be utilized.

Evaluation of Programs

What are the criteria by which one judges the worth of programed instruction? The answer to this question is readily obtainable. Have you ever watched an individual scan a programed textbook? Have you listened carefully to what he says about it? I wish that I could evaluate a program as quickly as some of these people do.

In the past, a low error-count and the amount of time saved by teachers and pupils over conventional instruction have been advanced as the useful data in evaluation of programed instruction. Geis points out that all the error-rate indicates is that the student is making few errors in working the specific program, and says nothing about the goodness of the technique. The time saved may be a misleading criterion of individual differences in completing programs. Since no course is completely programed, the time devoted to learning may actually be increased. That is, when many of the fundamental ideas and principles are developed by programed instruction, the teacher may be led to devote more time and energy to the development of complex skills and abilities.

Another evaluative procedure has been the study on comparative effectiveness wherein *global* programed instruction has been compared with *global* conventional instruction to achieve *global* goals, the criterion usually being performance on global achievement tests. The results of such studies have been inconclusive and often contradictory, as may be noted in the April 1962 *Review of Educational Research* (28). A finding of no difference between results of the methods is not sufficient justification for adoption of the programing technique. The weaknesses of many of these studies are many, and one should be careful in making judgments from them. What is needed is not this *global* approach, but some carefully designed studies centering around the way programed instruction can be used to achieve limited goals or specific objectives.

While there is little empirical evidence to support a definitive answer, perhaps another valuable criterion of the acceptability of programed instruction would be the degree to which *transfer* occurs from learning in the largely verbal situation to the nonverbal or applied situation. Because transfer is a major aspect of all education, we need more research in this area to use as a means of judging the value of the technique.

If none of the above are satisfactory criteria, what is an adequate criterion? There is only one, and that is: Does the student achieve the desired terminal behaviors that programing is designed to produce? This is the most significant one, but even it will be unsatisfactory—as I earlier pointed out—if we do not adequately state the terminal behavior.

Outside of the criterion of student achievement of stated behavioral goals, about all that can be offered at the present time as aids to evaluation are some guidelines developed from experience. Guidelines recently established by the joint committee from the AERA, APA, and the DAVI of the NEA (27) are useful for programed instruction in general. Because programed instruction will stand or fall upon the worth of individual programs, a functional set of guidelines for them has been suggested by Rothkopf (25). His thesis is that the merits of a program be specified on the basis of achievement on a suitable performance test of students who had used the program under specified conditions. A detailed listing of these conditions appears in the most recent issue of *AV Communication Review* in an article by Lumsdaine (15).

Human Relations

My first thought was to call this responsibility "Public Relations," but I rejected it on the ground that some persons might think I was dealing only with parents and other lay people, and not school personnel. I feel that AV specialists will have a strong responsibility to explain this new technique not only to parents and lay people but to students, teachers, and administrators. As we all know, this requires skill in human relations as well as in public relations.

When talking to various teacher groups about programed instruction, I have observed a rather negative reaction to it. This reaction may indicate one or several tendencies: a natural distrust of gadgets or machines; a defensive attitude toward present practices and dislike of innovation; a feeling that programed instruction threatens the teacher's present position as controller of the group; or even some ham in us—the desire to be an actor in front of a class. I think this reaction has also been somewhat magnified by the fact the initiation and development of programed instruction has come largely from nonschool sources. It perhaps reflects a distrust of the "animal psychologist" and his inferences that experimental studies in pigeon learning can have application to human learning. My reactions are somewhat like Crowder's who believes that teaching machines are a threat to teachers; not in the sense that they will replace teachers but rather cause them to develop new and different roles (1). Programed instruction can be sold to teachers if you point up to them that the technique may free them to do the job they would most like to do. Increased use of programed instruction might actually raise teacher morale. As Mager notes, successful programs can develop desired behaviors and thus may cause the teacher to experience success for the first time in seeing students accomplishing realistically stated instructional goals (18).

What about students, now that we have sold teachers? This question might be answered with another: To what extent have we seriously considered the student and the introduction of new techniques in the past? The individual nature of programed instruction is going to cause us to become more concerned with

student reaction than in the past. At the present time, student acceptance of programed instruction has been variable. Some like it immensely, while others do feel it is impersonal. Success on some programs may be due to the novelty of being away from the classroom and teacher. I suspect Hawthorne effect is a big variable in accounting for the success of many programs. The relative recency of programed instruction has not given us the opportunity to study the acceptance of the technique by students as they progress from school entrance to graduation. If it were made an integral part of the school day, we might find in twenty or thirty years from now that it would be accepted just as are many of the other once new media which were introduced into the classroom in the past.

I deliberately am not going to discuss the administrator's role. In examining materials to prepare this paper, I found that there were many articles discussing the principal's or administrator's responsibility for programed instruction. I felt, therefore, no great compulsion to discuss the administrator's responsibility. Since most of us work for some administrator, we have learned how to conduct our relations with such individuals; consequently, little elaboration is needed on this point.

In accepting responsibility for programed instruction, AV specialists will have to work not only with teachers, students, and parents but also with the public. The problem here may be perhaps more frustrating since so few persons know the real nature of teaching machines, yet consider themselves competent critics of educational methods. The press and related media have not always been helpful in explaining instructional technology, particularly programed instruction, to the public. In fact, one general issue has been raised—teacher *versus* machine—to further confuse the problem. How can we fight such sensationalistic terms or headlines as "canned," "mechanistic," and "machines no substitute for teachers," or "Can of Oil to Replace Apple for Teacher"? I recommend strongly that you read George Gerbner's recent paper on *Instruction Technology and the Press* (8) for insight into how this issue has developed. Many of us in programed learning read with great dismay the advertisements currently in existence extolling the merits of teaching machines in true huckster fashion. There is no patented solution to this problem except to conduct programs designed specifically for parents to inform them not only about programed instruction in its present state, but all instructional technology.

Direct writings on how to secure acceptance of programed instruction are relatively few. The majority has been largely of a technical nature and directed toward professional persons like you and me. There have been one or two good television programs explaining the subject, but these have reached rather limited audiences because of presentation at non-prime time. Two recently released instructional films can be used to inform the public about programed instruction: *One Step at a Time: A Filmed Report on Programmed Instruction,* distributed by the American Institute of Research (12), and the DAVI-sponsored film, *Teaching Machines and Programmed Learning* (2). Since both films present an introduction to the topic, they are useful for lay groups. Facilitating of this responsibility will depend upon your knowledge in the area as well as your

own reactions to the technique. My own feeling is that we can secure acceptance of programed instruction by students, teachers, administrators, and the public if we can demonstrate that it is effective in producing learning.

Conclusion

I have tried to present briefly what I think the responsibilities of AV specialists will be for programed instruction in the future. Some writers have claimed that the introduction of new techniques such as radio, films, and instructional television has not been adequately handled in the past. This says, in effect, that responsibilities were not seen nor anticipated or, if seen, not met. Such a situation should not occur again because we have been forewarned with regard to programed instruction. We know it is here. We know it can teach. We must, therefore, understand it, work with it, evaluate it, and inform about it. Only then can we clarify and justify the role programed instruction will play in the future of education. To me, the essence of AV responsibilities are summed up by Douglas Porter in the January 1962 issue of *Audiovisual Instruction* (20):

> For too long now, the approach to teaching hardware has been: here it is, our new closed circuit TV, teaching machine, tape recorder or what have you—what can we do with it? This has lead to the uneconomical and sometimes ineffective use of educational facilities. The more fruitful approach is to say: here are the aims of the course or lesson; how can we fulfill them? What combination of equipment and techniques will best achieve our aims? In this way, the true expertness of the audiovisual man can be realized as he analyzes the relationships between characteristics of his equipment, the demands of the learning principles, and the requirements of the subject matter.

When we can answer these questions, then I believe we will have met our responsibilities. If we cannot, then much hard work lies ahead of us.

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